Pannett, demonstrates that practical classes in physiology are not confined to universities and colleges of university standard. The book itself is not a serious contribution to scientific literature, and its authors have neither the requisite training nor knowledge to make it such. It is a mere compilation or *rechauffé* from other well known text-books. One notes that one of the authors blazons upon the title-page that he has obtained a scholarship at the inter. M.B. examination at the University of London, and this is a fair index of what the reader may expect in the interior of the volume. A note-book carefully kept by any moderately good medical student would be equally worthy of publication.

W. D. H.

Laboratory Notes on Practical Metallurgy: being a Graduated Series of Exercises. Arranged by Walter Macfarlane, F.I.C. Pp. x+140. (London: Longmans, Green and Co., 1905.) Price 2*s*. 6*d*.

THIS little book is apparently intended as a first course for beginners in practical work in a metallurgical laboratory, and especially for those who are preparing for the examination of the Board of Education in stages 1 and 2 of practical metallurgy. For these classes of students it will be useful and deserves commendation.

It consists of a series of practical exercises, all well within the grasp of the average boy, graduated and arranged with the view of developing the habit of observation, and the instructions given for doing them show a much more intimate acquaintance with the simpler operations of a metallurgical laboratory than is generally found in works of this class. In the first eighteen pages the student is introduced to furnace work by simple experiments on the melting of metals under various conditions, to prepare him for the subsequent more difficult operations.

The preparation of the ordinary common alloys follows, and then a series of well-chosen exercises illustrates the oxidation of metals and the reduction of metallic oxides and sulphides. Later, the more complex subject of the principles on which the processes for the extraction of copper, lead, gold, and silver from their ores depend is dealt with.

The book concludes with a few elementary exercises in assaying gold and silver ores, and the analysis of coal and coke. In the appendix are several tables, the most important being one giving the percentage composition of some of the common alloys.

There are a few slips and blemishes in the text, but they are for the most part trivial, one of the chief being in the table just mentioned, in which the composition of the British gold coinage is given as gold 91·66, silver 8·33; the latter should of course be "copper." The book contains much useful information for junior students, and can be recommended for their use.

Le Liège. Ses produits et ses sous-produits. By M. Martignat. Pp. 158. (Paris: Gauthier-Villars and Masson et Cie.) Price 2.50 francs.

THE latest addition to the "Encyclopédie Scientifique des Aide-Mémoire" is divided into two parts. The first part is concerned with the formation of cork in *Quercus suber,* the distribution of the tree, its treatment, its maladies and enemies, &c., and concludes with an account of prices and other commercial considerations. The second part describes how the natural product is treated in the manufacture of corks of all kinds, and how it is utilised in the production of linoleum and other materials.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Charge carried by the α Rays from Radium.

No special difficulty has been experienced in showing that the β particles (electrons), expelled from radium, carry with them a negative charge of electricity. The positive charge left behind on the vessel containing the radio-active material is simply and strikingly illustrated in the arrangement devised by Strutt, which is now popularly known as the "radium clock."

Since the α particles are deflected by a magnet as if they carried a positive charge, it is to be expected that this charge should be easily detected; but all the initial experiments made for this purpose resulted in failure. Since there are four products in radium which give out α particles, and only one which gives out β particles, it is theoretically to be expected that four α particles should be expelled from radium for each β particle.

In the Bakerian lecture (*Phil. Trans.,* series A, vol. cciv., p. 212, 1904) I described some experiments that were made to determine the charge carried by the α particles. About half a milligram of radium bromide was dissolved in water, and spread uniformly over a metal plate and evaporated to dryness. With a plate of 20 sq. cm. in area, the absorption of the α rays in the thin film of radium bromide is negligible. The solution of the radium released the emanation, and, several hours after removal, the activity of the radium fell to about one-quarter of its maximum value, and the β and γ rays from it practically disappeared. The experiments were made with the radium film at this minimum activity, in order to avoid the complication which would ensue if the β particles were present. An insulated plate was placed parallel to the radium plate and about 3mm. away from it. The apparatus was enclosed in an air-tight vessel, which was exhausted to a very low vacuum. The current between the plates was measured by an electrometer. The saturation current between the plates rapidly fell with decrease of pressure, but soon reached a limiting value—about 1/1000 of the initial—which could not be reduced further, however good a vacuum was obtained. No certain evidence that the α particles carried a positive charge could be obtained. It was thought possible that the inability to reduce the current below this value might be due to a strong secondary radiation, consisting of slow-moving electrons, which were liberated by the impact of the α particles on matter. Strutt (*Phil. Mag.,* August, 1904) has also observed a very similar effect, using a plate of radio-tellurium, which is well suited for this purpose, as it gives out only α rays.

J. J. Thomson (*Proc.* Camb. Phil. Soc., November 14, 1904; see NATURE, December 15) has recently shown in a striking manner that a large number of slow-moving electrons are liberated from a plate of radio-tellurium, although this substance is supposed to emit only α particles. These electrons could be readily bent back to the plate from which they came by the action of a magnetic field. No indication, however, that the α particles carried a charge was obtained.

I have recently attacked this problem again, using the methods and apparatus previously described, but, in addition, employing a strong magnetic field to remove the slow-moving electrons present with the α particles. The apparatus was placed between the pole-pieces of an electromagnet, so that the field was parallel to the plane of the plates. In such a case, most of the escaping electrons describe curved paths and return to the plate from which they set out. On application of the magnetic field, a very striking alteration was observed in the magnitude of the current. The positive and negative currents for a given voltage were greatly reduced. The upper plate, into which the α particles were fired, rapidly gained a positive charge. In a good vacuum, this was the case whether the lower plate was charged positively, or negatively, or connected to earth. The magnitude of the charge, deduced from these experi-

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ments, was found to be practically independent of the voltage between 0 and 8 volts. When once a magnetic field had been applied, of sufficient strength to stop all the slow-moving electrons, a large increase in its value had no effect on the magnitude of the positive charge. I think these experiments undoubtedly show that the α particles do carry a positive charge, and that the previous failures to detect this charge were due to the masking action of the large number of slow-moving electrons emitted from the plates.

Observations were made under different experimental conditions, and with very concordant results. In one set of experiments a weight of 0·19 mg. of radium bromide was used, spread on a glass plate, which was covered with a thin sheet of aluminium foil; in the other 0.48 mg., spread on an aluminium plate. The saturation current due to the latter plate, measured between parallel plates 3·5 cm. apart by means of a galvanometer, was found to be $7{\cdot}8 \times 10^{-8}$ amperes. It is possible that the failure of Prof. Thomson to detect the positive charge carried by the α rays from radio-tellurium was due to the smallness of the effect to be measured; for with the plate of radio-tellurium in my possession, the current was only about 1/40 of the above value.

Since the film of radium bromide is so thin that all the α particles escape from its surface, it is easy to deduce from the observed charge from a known weight of radium the total number of α particles expelled per second from one gram of radium bromide. Taking into consideration that half of the α particles were projected into the radium plate, and assuming that the α particle carries the same charge as a gaseous ion, it was deduced that one gram of radium bromide emits $3{\cdot}5 \times 10^{10}$ particles per second. Now the activity of radium bromide in radio-active equilibrium is four times this minimum, and contains four products which emit α particles at the same rate. It is thus probable that one gram of radium bromide in radio-active equilibrium emits $1{\cdot}4 \times 10^{11}$ particles per second. I had previously deduced (*loc. cit.*), from indirect data, the value about $1{\cdot}1 \times 10^{11}$, so that the theoretical and experimental numbers are in very good agreement.

I have also made experiments, by a special method, to determine the total number of β particles emitted from one gram of radium bromide in radio-active equilibrium, and have found a value about the same as the number of α particles emitted at its minimum activity. It is thus seen that four α particles are expelled from radium for each β particle. The number of β particles obtained by Wien was much smaller than this, but, in his experiments, a large proportion of the more slowly moving β particles was absorbed in the radium itself and in the envelope enclosing it.

The number of α particles expelled per second from one gram of radium is a most important constant, for on it depends all calculations to determine the volume of the emanation, and of helium, the heat emission of radium, and also the probable life of radium and the other radio-elements.

E. RUTHERFORD.

McGill University, Montreal, February 10.

Compulsory Greek at Cambridge.

THE conclusion to be drawn from Mr. Bateson's letter seems to be that it is useless to compel candidates to get up subjects for which they have no aptitude, or in which they take no interest. The glories of "another world," whether in science or art, are reserved for those that can see them, and a bright boy, not to say a dull one, is unlikely to discover the beauties of compulsory Greek, if he happens to have a distaste for dead languages. But is it not rather a narrow view which recognises only one new world and the entrance to it through compulsory Greek? It is said of a great creative mathematician that surveying his subject from a high pinnacle of abstract thought, he exclaimed, "And we too are poets"; but the most enthusiastic would scarcely expect this feeling to be aroused by compulsory mathematics in a dull boy; it does not seem to have occurred even to an exceptionally bright one.

Sullied, as Mr. Bateson seems to consider mathematics, by a degrading usefulness to "trade and professions," it nevertheless remains of essential importance to nine-tenths of our scientific work, and most of those of us who have but little of it sigh that we have not more. Mr. Bateson himself has not disdained its assistance in his work on breeding and heredity.

The point of previous letters is not that the writers had no aptitude for Greek, but that they found it useless to them in the studies to which they devoted their life. German is indispensable; soon we shall have to read Russian too, and if a man is to keep abreast of his subject he must not only read German, but read it with ease, so great is the bulk of literature to be got through. Arbitrarily to compel a boy to learn Greek, which, if he does not appreciate it, will be perfectly useless to him, when he might be learning German, which, whether he likes it or not, is indispensable for the full pursuit of his scientific studies, seems to be one of the cruellest conceivable tyrannies of pedantic folly. Could there be greater intellectual waste, and could any means be designed more likely to defeat the end for which it is designed? Compulsion and education are terms as opposed philosophically as they are etymologically; let the student be encouraged to work at the subjects he has really at heart and he will proceed from one success to another, and may even find his training in natural science leading him to the higher things in Greek literature.

But since the most natural classification of candidates would seem to be into those having a tendency to exact thought—who will naturally gravitate towards mathematics, and those with a love of art—who will naturally aspire to literature, and those with a little of both—who will be given over to natural science, why not allow a first class in any two of the three to count as a pass? such a measure would prove a great relief both to congenital non-mathematicians and non-linguists.

Finally, why should a want of sympathy with Greek, the noblest language of the noblest literature the world has known, be imputed to those who think that it is too good a thing to be wrested to injurious purposes?

X.

IF Mr. Bateson's case is that of hundreds, I make bold to say the case of the boy who wastes hundreds of hours on Greek grammar is that of thousands.

We do not want to abolish compulsory Greek because it has no value in the market, but because, stopped where the boy who takes it no further than the Little-Go stops it, the study of Greek has no value, ninety-nine times out of a hundred, in the forming of an active, living intelligence.

Mathematics may have contributed nothing to the formation of Mr. Bateson's mind; it is not unlikely, though it is deplorable. But if Mr. Bateson seriously thinks that elementary mathematics contributes no more than elementary Greek to the sound training of an average mind, surely he is curiously destitute in experience of the run of faculties in a young human being. This explanation of Mr. Bateson's astonishing argument suggests itself the more readily, because his idea that Greek is one of the things that put "one touch of art in the life of a dull boy, and open his eyes to another world," appears absolutely grotesque.

The narrow (and conspicuously *unintelligent*) utilitarian idea of education represented by Mr. Bateson's "intelligent lady" must be fought with all our strength, but it cannot be fought successfully with the rusty sword of Mr. Bateson's reactionary classicism. That is a weapon which will break in our hands and leave us defenceless to the spoiler.

A. G. TANSLEY.

New University Club, London, S.W., February 23.

MAY I be permitted to suggest, with all deference, that Mr. Bateson's statement that his knowledge of mathematics is "*nil*" must be taken *cum grano*! He is now, I believe, largely engaged in the business of counting chickens before they are hatched. How could he do this without some mathematics? As a matter of fact, the research in which he is engaged involves mathematical conceptions of no mean order, yet I presume he knows something about his subject.

Mr. Bateson's letter might be a good argument in favour of lowering the mathematical standard in the previous examination. But, as he uses it, it is merely an unusually frank example of the reasoning which is the real support of compulsory Greek, *viz.*, "When I was a little boy the big boys bullied me; now that I am a big boy myself I mean to take it out of the little ones!"

EDWARD T. DIXON.

Racketts, Hythe, Hants, February 24.

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